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Cockbain, M.M. and Blyth, C.M. and Bovill, C. and Morss, K. (2009)
*Adopting a blended approach to learning: experiences from radiography
at Queen Margaret University, Edinburgh.* Radiography, 15 (3). pp. 242-
246. ISSN 1078-8174

<http://eprints.gla.ac.uk/25710/>

Deposited on: 26 March 2010

Key Words: programme redesign; blended learning; learner centred.

Introduction

Radiography is an 'active' profession in terms of its practical application, the different environments in which it takes place and the client groups and members of the multidisciplinary health care teams encountered. It is therefore important to provide students with an 'active' educational experience to prepare them for their professional life and to meet the Standards of Education and Training.¹ Increasingly, expectations within the profession and those of its stakeholders are that radiographers will work autonomously, demonstrate the ability to analyse and evaluate the needs of health care delivery, understand roles of other health care professionals and optimise patient care through using a critical and reflective approach to decision-making.

In higher education the theory and practice of learning and teaching encourages individuals to become autonomous and take responsibility for developing their professional knowledge and skills and to place value on lifelong learning.^{2,3} In order to respond to the external professional requirements and those of the university, radiography programmes need to provide opportunities for students to learn in ways that will increase student responsibility for their own learning, reduce their level of dependence on staff and prepare them for the rigours of the workplace by developing high level cognitive and transferable skills.

This paper outlines significant and substantial changes to the following three programmes at QMU: Postgraduate Diploma in Radiotherapy and Oncology; BSc (Hons) Diagnostic Radiography and BSc (Hons) Therapeutic Radiography.^{4,5} These changes represent a paradigm shift in the way students learn, with academics undertaking radical alterations to the way they 'teach'. These developments have been enabled by careful curriculum design which optimizes the face-to-face and

electronic elements of a blended approach to learning and aims to enhance students' control over their own learning.⁶

Background and Rationale

Before changes were made to programme delivery, it was the consensus of the teaching team that students were highly dependent on staff and often engaged in surface learning.⁷ What was predominantly a 'transmission' mode of delivery was not effective. The team therefore felt that a significant shift in pedagogy was required in order to increase deep learning and enhance autonomy. The programme needed to become more flexible to be inclusive of the varied demands and requirements of learners. Student/staff contact time needed to focus more on high quality discussion and problem solving in order to facilitate student engagement and deeper learning.⁸ The staff also wanted to create learning communities grounded in principles of equality and of collegiality, fostering genuine discussion and peer support.

Prior to programme redesign both undergraduate (UG) programmes used a traditional lecture and tutorial approach with a high level of face-to-face contact between lecturers and students. In addition modules had become so generic that the level of specialist knowledge and skills being taught was not adequate in preparing students for clinical practice. Feedback from clinical placement staff supported this view. Students were failing to make connections between academic and clinical modules. Increasingly academic modules were not constructively aligned with the students' current level of clinical learning outcome.⁹

The juncture between development of the pre-registration Postgraduate Diploma in Radiotherapy and Oncology and the review of the UG programmes offered the opportunity to incorporate some of the emerging ideas about blended learning⁶ and the innovative use of the virtual learning environment, WebCT. A blended learning approach to teaching and learning activities was chosen as it involves the planned combination and integration of face-to-face classroom activities

with live, directed and self directed e-learning opportunities. This blended approach was not an 'add on' to the existing didactic approach as redevelopment of the programme allowed for full integration of the online and face-to-face elements. Additionally the academics believed that effective blended learning facilitates a community of learning and inquiry by encouraging discussion, debate, negotiation and agreement which are seen as attributes of higher education.¹⁰

The new design assumes that independent study through WebCT will be central to delivery and time with staff will be spent developing high level cognitive, transferable and practical skills.

WebCT is a powerful electronic environment offering fresh possibilities for our pedagogical approach. The facilities it offers are web-based tools which allow instructors and facilitators to build and manage learning content and provide an engaging environment for students. There are tools to facilitate student participation, communication, collaboration, assessment and evaluation, all of which are pivotal in achieving the blended approach to teaching and learning staff were looking to achieve. If used as an integral part of careful programme design, it is possible to produce a programme which supports synthesis of the skills, knowledge and competencies required in the academic and clinical environments.

Programme Redesign

Programme redesign was informed by the key pedagogical theories of social learning,^{11,12} constructivism¹³ and experiential learning.¹⁴

Constructivists, as the name implies, view learning as being 'constructed' on the foundations of prior knowledge and as an active rather than a passive activity. They see active engagement between the learner and what is being learnt as a process which adds new knowledge, in a way that is understandable to the learner, to what they already know. The constructivist learning environment encourages the learner to gain the skills for finding suitable solutions to the real world problems they will

encounter.¹⁵ Interaction with the social environment is also central to the development of understanding and specifically, interaction with others is seen to provide the forum for testing understanding and to view the understanding of others.¹⁶

Within the framework of experiential learning, defined as the 'process whereby knowledge is created through the transformation of experience',¹⁴, it can perhaps be stated that everyone has a wealth of experience that can be used to develop skills.¹⁷ Eriksen (2001), in McAuliffe (2001),¹⁶ agree, stating that all students bring their experiences into the learning environment to inform the learning of others and this type of engagement is important to the redesign of the programme. It is this connection with others that moulds a community of inquiry as it encourages dialogue of a reflective nature in both written and verbal forms and these varied forms of interaction meet the students diverse learning requirements.¹⁰

Most professional knowledge is acquired through university based education and this may be too limited to allow newly qualified graduates to manage the complex problems encountered in everyday professional practice. The splitting of theory and practice is seen to cause an 'unnatural divide for both professionals and their clients'.¹⁸ There has been active collaboration between clinical and academic staff throughout programme redesign to ensure full integration of the blended learning model. This has seen the development of workshops in both clinical and academic environments utilising staff from both areas of expertise in the educational process. Clearly therefore, the model of choice for curriculum design was 'constructive alignment'.⁹ This model states that individual learning results from what the learner engages in and that teaching/learning activities and assessments must harmonise with the learning outcomes of the programme in order to support that learning. Consequently an enquiry-based, student-centered approach was adopted involving active engagement between the learner and what is being learnt. Enquiry-

based learning inspires students to learn for themselves and brings a research-orientated approach to the subject.¹⁹

The role of the lecturer was to become that of a facilitator of learning who should take into account the ability and prior knowledge of the learners as they set the learning task.²⁰

Implementation

To increase learner engagement within modules, the WebCT area has been designed to be colourful and attractive in order to interest students and encourage them to explore the area.

Students are provided with paper and online copies of study guides which outline the modules and clearly state areas of study for each week of the semester. They are encouraged to use these as a schedule for study and as a scaffolding to support their learning.

Developing Student Autonomy

Enhancing students' responsibility for their own learning is crucial within teaching.²¹ Modules that commence in the first year are planned specifically to support early development of responsibility and autonomy and to introduce students to the concept of blended learning.

In these early stages there is more face-to-face tutorial time scheduled to support students to further develop responsibility and autonomy. This allows them to raise concerns and ask questions relating to specialist subject areas and WebCT use. There are handouts and quizzes as well as task-based discussions that all aim to encourage students to become more engaged with the subject as well as with their tutor and peers. Materials and tasks within the WebCT area are directly relevant to regular tutorial sessions and therefore help to connect student engagement online with student engagement in the classroom.

Students can, and are expected to, access learning resources within WebCT at times convenient to their individual learning requirements. For example the inclusion of a number of narrated PowerPoint presentations within the online materials, along with accompanying scripts, allow students to choose when and how they engage in the subject matter. It also enables students to revisit the material as many times as they wish and is a valuable resource for revision prior to assessments. Because today's student population has diverse needs, they benefit from flexible access to electronic learning resources in academic, clinical and off-site environments. Programme evaluation has demonstrated that the extended access to these materials is particularly useful to students with special educational needs or those whose first language is not English.

Lecturers also provide tutorial materials online and make it clear that students are expected to study them and prepare for the face-to-face discussions. With narrated PowerPoint presentations replacing some lectures, students soon realise the importance of using the contact time with lecturers for useful discussion. A clear message from lecturers early in the programme, and the lack of content-laden face-to-face sessions prompts students to prepare and keep up-to-date.

Developing Cognitive and Transferable Skills

Students learn through online tasks and by having opportunities to use and experience these resources in a way that best suits the individual learner.^{14,22,23} These experiences provide students with a framework to learn to analyse and synthesise their knowledge. Face-to-face tutorials and online discussion focus on enquiry-based learning with difficult concepts or challenging case studies provided by the lecturer or from students' practice placements. For example, they are required to debate and negotiate why particular clinical approaches should be adopted by justifying their opinions with appropriate evidence. Discussion with regard to how the radiographer would liaise with colleagues from a multi-professional team to ensure the best care for the patient focuses on the patient's needs and enables lecturers to

encourage students to use a wide range of knowledge gained in, for example, anatomy or cytology, and connect this knowledge to the reality of the patient experience. These activities, along with group work tasks, also help develop teamwork and communication skills.

Developing a Learning Community

The individual construction of learning is complemented by the communal spaces within WebCT through the use of interactive online asynchronous discussions. Discussions help students to make sense of their learning within a social community and examine their own knowledge, skills and views against those of others. This renegotiating of meanings and learning with others is consistent with theories of social learning,¹¹ social constructivist learning in virtual environments²⁴ and the concept of learning communities and communities of practice. The presence of a community is essential to stimulate the commitment required by students to aid their progression through the stages of critical inquiry.^{12,25} These academic and social communities create a broad peer and lecturer support network for students that facilitates learning, strengthens links between university and clinical placements and contributes to progress at university through enhanced social and academic integration.²⁶

Students are often asked what they would like to discuss in tutorials. In one undergraduate module students complete a quiz online and then discuss in tutorials anything they fail to understand. Discussion in class and online enables lecturers to know the way students are learning and thereby adjust tutorials to student needs. Student tracking tools within WebCT enable lecturers to ascertain how, and how often, students are using the online area and this helps them to respond more quickly and in a more tailored manner to individual needs.

The online format allows the lecturer to review all the discussions and to give feedback, correcting misconceptions if necessary. Students then have the

opportunity to appraise their responses against feedback. Some of this work is guided by the lecturer and other discussions are student-initiated and mediated. Students initiate requests for help as well as responding to their peers with support and advice. This is mediated by lecturers who help when needed. Students often offer their own unprompted help to one another by sharing useful information, reading and websites.

The new programme design aims to provide better alignment of topics being studied in university and better application of this knowledge in practice. In addition, links are strengthened between university and the workplace where students can access WebCT resources in their professional practice settings. The opportunity for quality discussion and debate with peers and lecturers aspires to help students to develop higher cognitive skills through reflecting on, and making sense of the resources they have studied online.

Assessment

In line with the adopted blended learning approach, assessment strategies adopt both traditional and on-line formats as it is not possible that one form of assessment can reliably assess student performance.²⁷ Modules use a wide variety of assessment methods throughout the programme and where possible, student choice is maximised within assessments to allow for the varying learning styles of the students.

It is important that students achieve professional competencies so assessments are designed to be relevant to real work situations. However, lecturers have attempted to redesign assessments to be both an assessment OF learning as well as an assessment FOR learning.²⁹

Online quizzes used for formative assessment are designed to enable students to judge their own performance and develop skills of self-appraisal useful for future learning.³⁰ The quizzes give students choice about when and how many times

they complete them. Feedback is available online, with the quizzes linked directly to face-to-face tutorials where students can ask further questions. Combined with lecturer and peer feedback this formative 'self-feedback' can be a valuable contribution to learning.³⁰ Students appreciate being able to use these available resources for revision at the critical stages they are needed. Where lecturers have removed quizzes to 'de-clutter' online areas, students who have failed to complete an online formative assessment are motivated enough to request additional access. A student proactively requesting assessment of any sort would not have occurred in the previous programme design.

In one module students are required to produce an essay with set learning outcomes. Each individual student delivers a short presentation to their peers and lecturer outlining how they will achieve the learning outcomes. Other groups will often express interest in similar areas of work so the students use online and tutorial discussion to negotiate. The lecturer guides students in ways that may improve their designs in order to better meet the learning outcomes or the student's own aims.

Students have opportunities to practice key skills in image interpretation through links to high quality electronic images. Using these resources, they can practice diagnostic skills online with opportunity for repetition, practice and revision until they develop confidence in their skills. Discussion in tutorials offers students an opportunity for formative feedback before having to interpret radiographic images in examination conditions.

Many departments now use digital and/or computerised technology to capture images and students are currently required to interpret images in both traditional and digital formats. Digital images are smaller than the traditional format so increased image interpretation skills are required to detect subtle abnormal variants. Before introducing summative Objective Structured Pattern Recognition and Image Interpretation Examinations (OSPRIIE) in an electronic format via WebCT, students were only assessed on their interpretation of the traditional radiograph. The new

strategy mirrors clinical practice in a modern electronic environment. This does not however totally exclude the use and interpretation of traditional radiographs which are utilised throughout the professional modules and in image interpretation workshops.

Conclusion

There is no one 'right' media for the delivery of any programme as each has its own drawbacks. It could be argued that the main one in the redesigned programme is the lack of social interaction that takes place in a conventional setting. However, the perspective of the radiography teaching at QMU was that the previous lack of alignment between academic and clinical modules was not optimum in helping students to learn and make links between theory and practice. The explicit connections that now exist between the focus of the programme in university and the opportunities for applying knowledge in practice allow students to engage more deeply through applying their knowledge of the subject in practice. On-going evaluation of learning is taking place and the results of this evaluation will be published.

Students can choose when and how to engage as programmes change from the old style lecture and tutorial format to an emphasis on blended learning. Students engage in these tasks individually or collaboratively and construct their learning in ways that are more individually meaningful. Lecturers now plan learning activities that build upon the skills students have already gained through their awareness of how students are learning in group sessions, online and in class.

Traditionally a lecturer can only assess a student's learning through their finished products, through the questions they ask, their absence from class, or their final engaging presentation. However, through online discussion tools in WebCT, lecturers can see more clearly which students are engaging deeply in learning, which students are really struggling and the level of contribution different students

demonstrate. Lecturers can gauge when to offer more support and when to leave students to work things out for themselves.

With the move towards a more learner-centred, blended educational experience for the students, the lecturers' role has shifted to that of a facilitator and has enabled staff to highlight to students that if they come unprepared for tutorials, the facilitator has no role. As a facilitator the lecturer can draw on their own experience and knowledge to move discussion onto higher cognitive levels.

Staff have realised that '*WebCT doesn't do it for you*'. The use of a virtual learning environment often brings early expectations that the online nature of work will mean less teaching and more free time. As staff realise how much material they need to pre-prepare, how often they need to access online discussions and assessments, this is in fact not the case as time is just allocated differently.

To implement such change is an evolutionary process requiring constant evaluation, revisiting and revising. Communication between all involved is essential for its success. Adopting a blended approach to incorporating on-line teaching strategies is a cultural change for both students and academic staff and commitment by all is paramount to the successful implementation of an effective electronic learning environment with positive support at subject and institutional level essential in enabling these changes to take place.

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